High Resolution Direct Detection IR Spectroscopy

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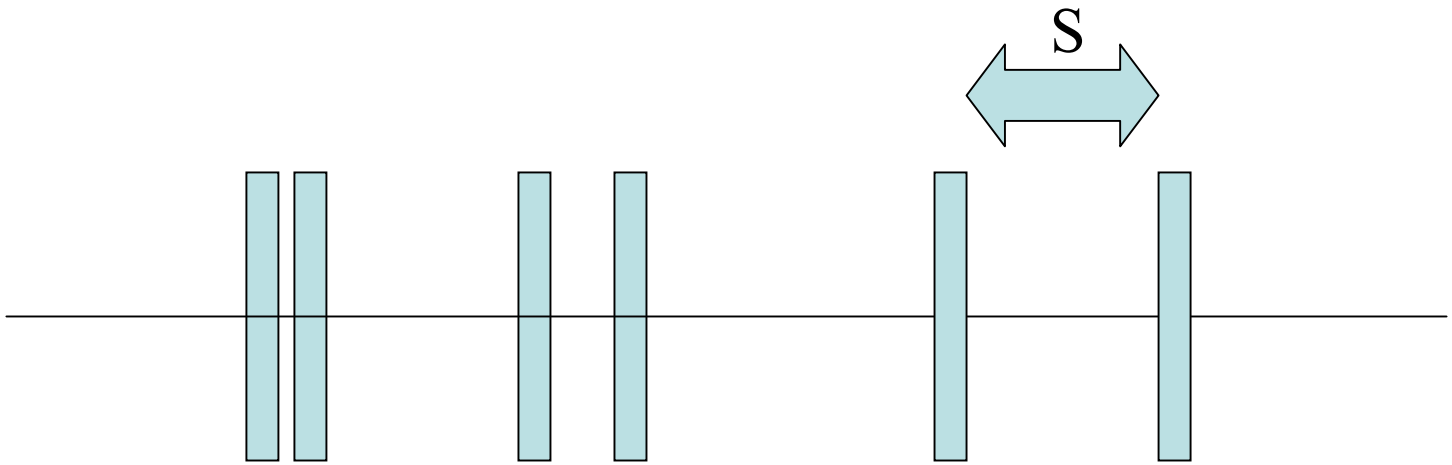
High Resolution Spectrometer Types

- Fabry-Perot imaging tuned filter, multiple stages, high order. Excellent for known small wavelength range, wide field, or ultra resolution in small volume
- Very large grating - first order, linear spectrum, can be combined with object selector or long slit. Excellent for large linear array detectors, size > R
- Crossed echelle and first order gratings, 2-D spectrum, good for point source, good for 2-D array detectors

High R Spectrometers

- Michelson imaging spectrometer, capable of imaging
  - good for wide field imaging spectroscopy
  - superior for small arrays of detectors that can't reach photon noise with narrow bandwidth
- Hybrids of imaging interferometer (FPI or Michelson) with dispersive system to beat down photon noise and gain spectral multiplexing with large detector arrays
- Heterodyne spectrometer
  - Superior for long wavelengths, very high R
  - Quantum noise limit = 1 photon/Hz/sec

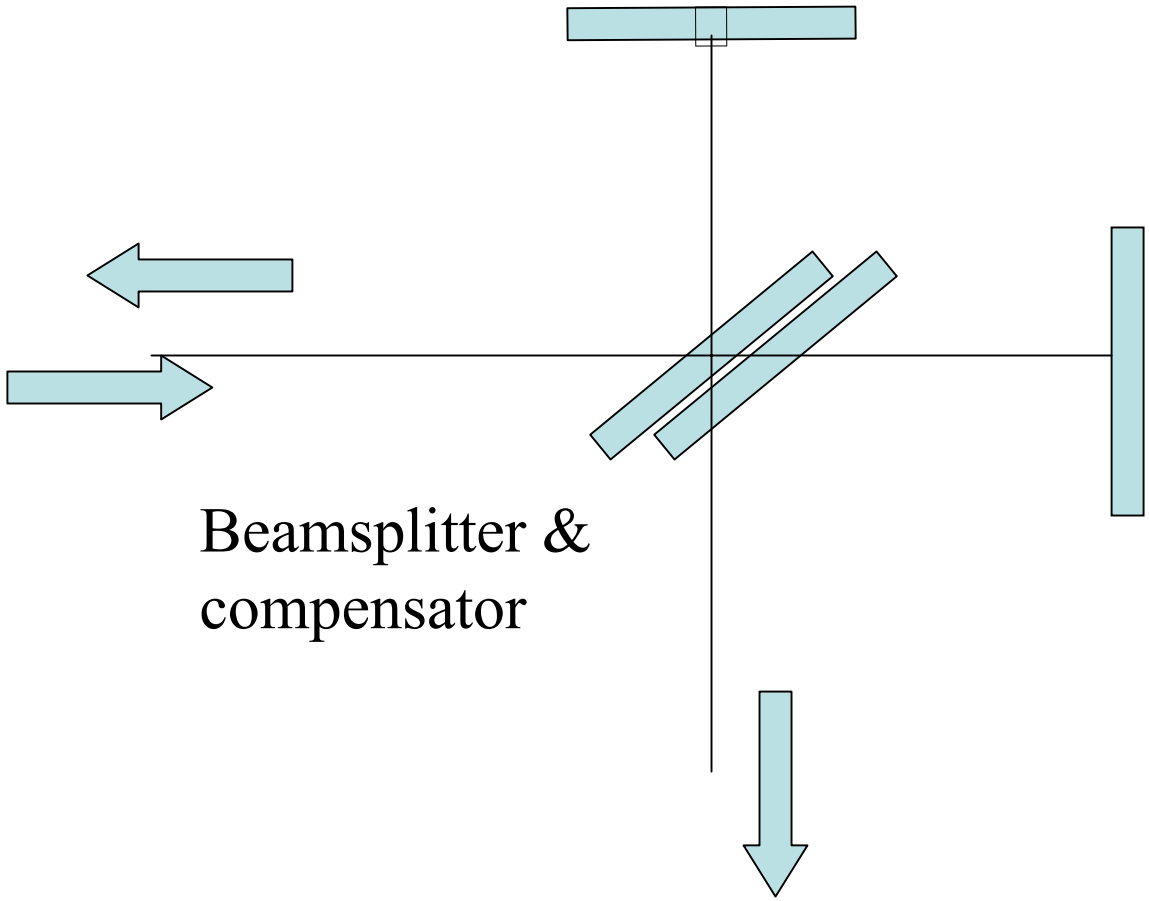
High Resolution Fabry-Perot



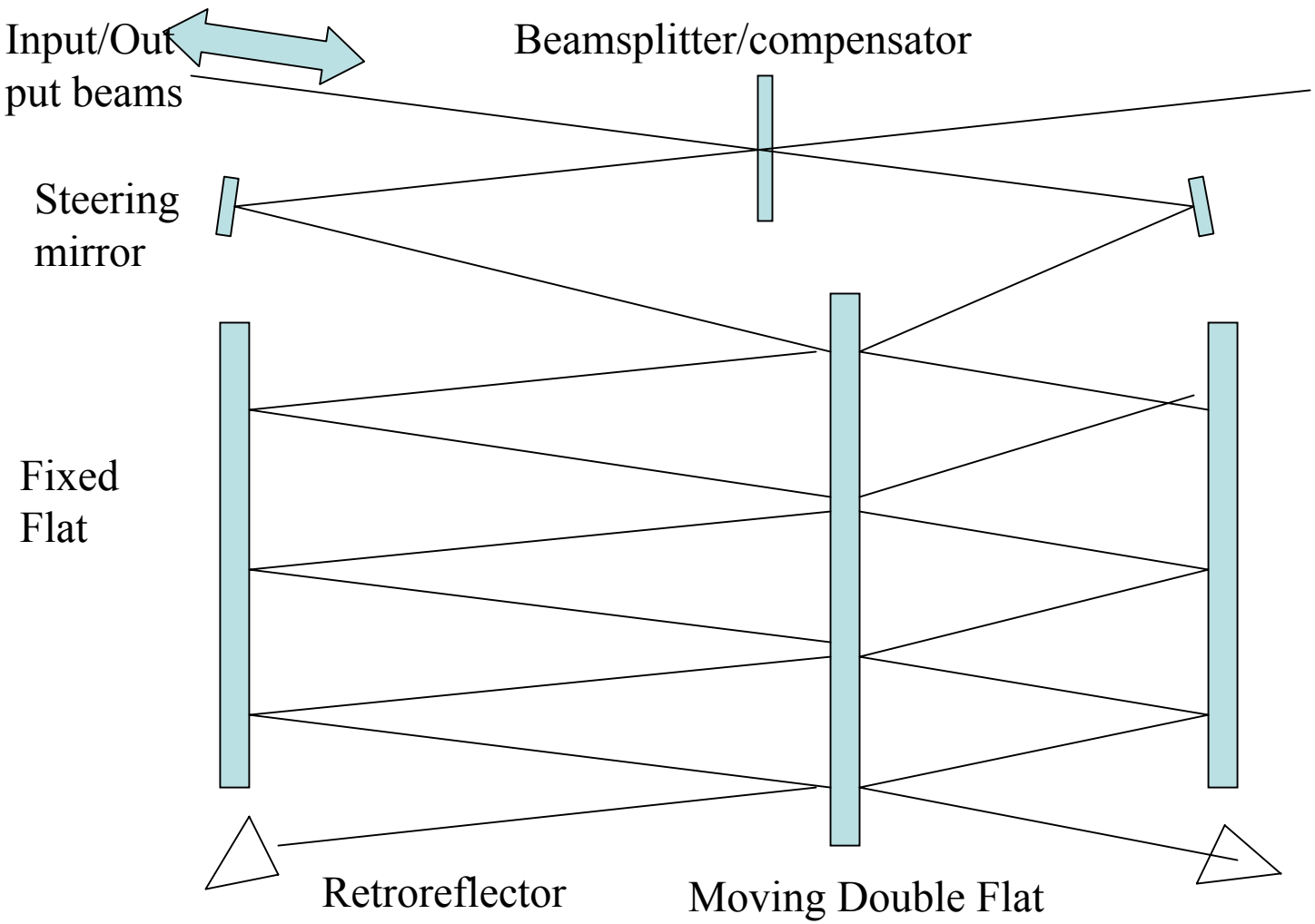
First Order | 100th Order | 10,000th Order

Imaging, tunable, resonant filter, requires synchronized tuning. Can make plates reflective with multilayer dielectric coatings or with capacitive and inductive meshes. Spectral resolution = $\lambda/\Delta\lambda \sim$ mean path difference $/\lambda = S/(\lambda(1-R))$

Imaging Michelson Spectrometer



Multi-Folded Michelson



Path Length Change = 32 * motion